IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

jc583 U.S. PTO
09/01/99

Applicant(s): Guy T. Blalock

Docket No.: 150.01010101

Title: DETECTION OF GAS PHASE MATERIALS

jc617 U.S. PTO
09/388286
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Assistant Commissioner for Patents
ATTN: Box Patent Application
Washington, D.C. 20231

We are transmitting the following documents along with this Transmittal Sheet (which is submitted in triplicate):
X Utility Patent Application: Specification (10 pgs); Claims (20 claims on 4 pgs); 1 pg Abstract.
___ Design Patent Application: __ pgs.
X 3 Sheets of informal drawing(s).
X A signed Declaration (2 pp.).
X A return postcard.
X An Assignment of the invention to Micron Technology, Inc. and Recordation Form Cover Sheet (2 pp).
X A check in the amount of $40.00 to cover the Assignment Recording Fee.
X Other: Election Under 37 CFR 3.71 and 3.73 and Power of Attorney (1 p.) .
X A check in the amount of $ 916.00 to cover the filing fee, which is calculated below:

APPLICATION FILING FEE					
	Number of Claims Filed (1)	Claims Included in Basic Filing Fee (2)	Number of Extra Claims (1-2)	Cost per Extra Claim	Fee Required
Total Claims	20	- 20 =	0	x $18 =	0
Independent Claims	5	- 3 =	2	x $78 =	$156
One or More Multiple Dependent Claims Presented? If Yes, Enter $260 Here →					N/A
Enter Basic Filing Fee (Utility Patent-$760/Design Patent-$310) Here →					$760
Total Application Filing Fee					$916.00

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PATENT

Docket No. 150.0101 0101

DETECTION OF GAS PHASE MATERIALS

Field of the Invention

The present invention relates to the detection of selected materials. More particularly, the present invention pertains to the detection of gas phase materials.

Background of the Invention

In the fabrication of integrated circuits, various layers of the same or different materials are used. For example, during the formation of semiconductor devices, such as dynamic random access memories (DRAMs), static random access memories (SRAMs), ferroelectric (FE) memories, etc., a variety of conductive and non-conductive materials are used in the formation of storage cell capacitors and also may be used in interconnection structures, e.g., conductive layers of contact holes, vias, etc.

These materials are typically supplied in a gas phase conducive to the formation of a film on a surface. When supplied in the gas phase, many of these materials may become toxic or otherwise harmful to health. As a result, it may be important to monitor where these materials are found and the concentrations in which they are found. Furthermore, because the effects may be cumulative, i.e., repeated exposure to low levels of the selected materials may be additive, it may be important to provide sensors and detection methods that are capable of measuring for cumulative exposure levels in addition to real-time exposure.

Semiconductor device manufacturing is one example of an environment in which the monitoring of exposure to potentially harmful materials can be advantageous. For example, various metals, metallic compounds, metal oxides, etc. are used to manufacture various structures used in semiconductor devices. A number of these materials may pose health risks based on exposure to the materials in the gas phase.

For example, ruthenium oxide and ruthenium have recently been employed in semiconductor devices because these materials are electrically conductive, conducive to conformal deposition, and they are easily etched. For example, the article entitled, "$(Ba,Sr)TiO_3$ Films Prepared by Liquid Source Chemical Vapor Deposition on Ru Electrodes," by Kawahara et al., Jpn. J. Appl. Phys., Vol. 35 (1996), Part 1, No. 9B (September 1996), pp. 4880-4885, describes the use of ruthenium and ruthenium oxide for forming electrodes in conjunction with high dielectric constant materials. It is, however, known that gaseous ruthenium tetraoxide (RuO_4) is toxic at very low levels, e.g., about 1 part per billion (ppb). Monitoring of exposure to ruthenium tetraoxide is, therefore, both important due to its toxicity and difficult due to the low exposure levels at which the toxicity becomes an issue.

For example, many detection systems or procedures for many different gas phase materials rely on chemically sensitive tapes. Stains are produced due to chemical reactions occurring on the tapes in response to chemical exposure and those stains can then be detected. Problems with such tapes may, however, include sensitivity to different chemicals.

With respect to ruthenium tetraoxide, some useful chemically sensitive tapes are also sensitive to other chemicals such as oxidizing agents. As a result, the tapes typically cannot be used to accurately detect exposure to ruthenium oxide. Other tapes may detect ruthenium oxide, but could not be used to accurately detect at desired exposure levels.

Summary of the Invention

The present invention provides sensors for and methods of detecting the presence of gas phase materials by detecting the formation of films based on the gas phase material. Advantageously, some gas phase materials preferentially deposit on specific surfaces. As a result, selective detection of those gas phase materials can be obtained by detecting films deposited on those detection surfaces.

In one aspect, the present invention provides for detection of gaseous ruthenium oxide (RuO_4) which preferentially deposits on a variety of surfaces, e.g.,

polypropylene. The deposited film includes elemental ruthenium (Ru) and/or ruthenium oxide (RuO_2) which exhibit relatively high electrical conductivity. As a result, detection of gaseous ruthenium oxide may be performed by monitoring electrical conductivity across a detection surface. Exposure levels may be determined based on the increases in electrical conductivity.

Advantages of the present invention include reduced sensitivity to environmental contaminants because relatively few environmental contaminants will deposit on any surface in the form of, e.g., an electrically conductive film. In addition, heating the detection surface may further improve sensitivity to environmental contaminants by reducing or eliminating deposition of environmental moisture and most organic materials.

Detection of the selected material or materials in the gaseous phase may serve a variety of purposes including the detection of toxic/hazardous materials to insure proper industrial safety standards; to monitor reaction levels for process control; to determine the integrity of containment systems; etc.

In one aspect, the present invention provides a method of detecting a gas phase material by providing a sensor including first and second electrodes, a detection surface extending between the first electrode and the second electrode, and a detector operatively connected to the first and second electrodes; exposing the detection surface to the gas phase material, wherein an electrically conductive film forms on the detection surface between the first and second electrodes; and detecting a change in conductivity between the first and second electrodes with the detector.

In another aspect, the present invention provides a method of detecting a gas phase material by providing a sensor including first and second electrodes, a detection surface extending between the first electrode to the second electrode, and a detector operatively connected to the first and second electrodes, wherein the detection surface is not electrically conductive; exposing the sensor to the gas phase material, wherein an electrically conductive film forms on the detection surface between the first and second electrodes; and detecting electrical conductivity of the electrically conductive film between the first and second electrodes with the detector.

In another aspect, the present invention provides a method of detecting a gas phase material by providing a sensor including first and second electrodes, a detection surface extending between the first electrode and the second electrode, and a detector operatively connected to the first and second electrodes; heating the detection surface above ambient temperature; exposing the detection surface to the gas phase material, wherein an electrically conductive film forms on the detection surface between the first and second electrodes; and detecting a change in conductivity between the first and second electrodes with the detector.

In another aspect, the present invention provides a sensor for detecting a gas phase material in an environment, the detector including first and second electrodes; a detection surface extending between the first electrode and the second electrode; and a detector operatively connected to the first and second electrodes.

In yet another aspect, the present invention provides a sensor for detecting a gas phase material in an environment, the detector including first and second electrodes; a detection surface extending between the first electrode and the second electrode; a heater capable of providing thermal energy to the detection surface; and a detector operatively connected to the first and second electrodes.

These and other features and advantages of the present invention are described below with respect to illustrative embodiments of the invention.

Brief Description of the Drawings

The present invention will be better understood from reading the following description of illustrative embodiments with reference to the attached drawings, wherein below:

Figure 1 illustrates one sensor according to the present invention.

Figure 2 illustrates another sensor according to the present invention.

Figure 3 illustrates another sensor according to the present invention.

Figure 4 illustrates another sensor according to the present invention.

Figure 5 illustrates one method of using a sensor according to the present invention.

Detailed Description of Illustrative Embodiments of the Invention

The present invention provides devices and methods for the monitoring of gas phase material levels by detecting films formed from the gas phase materials on detection surfaces. One example of an industry using gas phase materials is in the production of semiconductor and other micro-scale devices. Processing steps such as wet etching, dry etching, chemical vapor deposition, etc., may often use or produce gas phase materials that may be, e.g., toxic, corrosive, irritants,, etc. Detection of the gas phase materials may be desirable for safety, environmental, or process control purposes.

The present invention relies on the tendencies of the gas phase materials to deposit or form films or coatings on detection surfaces. In some instances, the gas phase materials will preferentially deposit on detection surfaces that are manufactured from particular materials or that have a particular structure. By capitalizing on those preferential deposition tendencies, the present invention offers advantages in monitoring for the materials.

As formed on the detector surface as a result of exposure to the gas phase material, the film may consist essentially of the gas phase material, the film may include one or more constituents in the gas phase material, or the film may be formed of the gas phase material or one or more constituents thereof in addition with other materials, in e.g., a matrix, dispersion, etc.

It may be preferred that, as deposited, the gas phase material or materials form an electrically conductive film or coating on a detection surface. By detecting changes in the conductivity between at least two electrodes on the detection surface, the present invention provides the ability to detect the presence of the gas phase materials.

Typically, deposition rate will be dependent on a variety of factors including, but not limited to the concentration of the selected material in the gaseous state, the properties of the detection surface (e.g., materials, temperature, morphology, etc.), and the environment in which the detection surface is located (e.g., temperature, pressure, etc.). Other variables affecting deposition rate may include deposition-enhancing factors, such as laser-assisted deposition, plasma generation, etc.

Regardless of the variables in deposition rate, however, it is preferred that the rate of change in conductivity correlate with exposure levels.

Figure 1 is a schematic diagram of one sensor 10 according to the present invention. The sensor 10 includes a first electrode 20 and second electrode 30. The two electrodes 20 and 30 are separated by a detection surface 40 that extends between the electrodes. The detection surface 40 may preferably electrically isolates the electrodes 20 and 30 such that current is prevented from flowing between the electrodes 20 and 30. Alternatively, the detection surface may provide low level conductivity between the electrodes 20 and 30 that increases as a conductive film is formed thereon.

The electrodes 20 and 30 are each electrically connected to a detector 50 that is capable of detecting a change in conductivity between the electrodes 20 and 30 across the detection surface 40 as a result of deposition of one or more gas phase materials in the form of a film or coating on the detection surface 40. It is preferred that low level depositions of a conductive film on detection surface 40 can produce a finite and accurately measurable change in current flow between electrodes 20 and 30.

The distance *d* between electrodes 20 and 30 may be used to control the sensitivity of the detector 10 to a particular gas phase material. Factors affecting the selection of an appropriate distance *d* may include, but are not limited to: resistivity of the deposited film/coating, resistivity of the detection surface 40 before deposition, ambient conditions (humidity, temperature, etc.), temperature of the detection surface 40, size of the electrodes 20 and 30, voltage across the electrodes 20 and 30, etc.

Depending on the properties of the selected material and/or their deposition states, the nature of the detection surface 40 may enhance or retard deposition and either of those results may be desired based on a wide variety of factors. In some instances, the material or materials exposed on the detection surface 40 can affect deposition of the gas phase material. In one illustrative example, gaseous ruthenium oxide preferentially deposits on polypropylene and, as a result, it may be preferred

that the detection surface include at least some polypropylene id ruthenium oxide is to be detected.

Alternatively, deposition on the detection surface 40 may be affected by surface morphology, e.g., whether the detection surface 40 is relatively smooth or rough. A rough surface may be structured by, e.g., molding, or randomly roughened by e.g., sandblasting, chemical etching, etc.

Furthermore, the detection surface 40 may be provided in a variety of forms or shapes. Examples of some detection surfaces are depicted in Figures 2-4. The detection surface 140 of Figure 2 is a generally planar surface on a substrate 142 that includes electrodes 120 and 130.

The detection surface 240 of Figure 3 is provided in the form of a wire 242 with a circular cross-sectional profile, although any desired cross-sectional profile could be used (e.g., square, rectangular, oval, etc.). The electrodes 220 and 230 are preferably located at opposite ends of a portion of the wire 242 and are separated by the detection surface 240. Although the depicted detection surface 240 extends about the periphery of the wire or rod 242, the detection surface may alternatively be provided as one or more portions of the surface of the wire 242.

Figure 4 illustrates yet another detection surface 340 provided on a sheet/film 342. Also seen in Figure 3 are electrodes 320 and 330 separated by the detection surface 340. All or portions of the sheet/film 342 may be treated to enhance or retard deposition of the selected materials as desired to achieve the desired detection sensitivity.

One illustrative method of detecting a selected material in the deposition state will now be described with respect to ruthenium oxide, although it should be understood that the methods of the present invention may be used to detect a variety of other selected materials. Other gas phase materials that could be detected by the device and methods of the present invention include any gas phase material that deposits on a detection surface in the form of an electrically conductive film or coating. It will be understood that the composition of the gas phase material will typically correspond to the composition of the film or coating, but that the exact compositions may be different. For example, gas phase ruthenium tetraoxide

(RuO_4) can be detected based on a film or coating including elemental ruthenium (Ru) and/or ruthenium dioxide (RuO_2), both of which are electrically conductive. Examples of other gas phase materials that can be detected according to the principles of the present invention include, but are not limited to, IrO_4 and RhO_4.

Ruthenium tetraoxide can be deposited by chemical vapor deposition (CVD) which is defined as the formation of a nonvolatile solid film on a substrate by reaction of vapor phase reactants, i.e., reacting gases, that contain desired components.

In a CVD process, the reacting gases are introduced into the reaction chamber. The gas is decomposed and reacted at a heated wafer surface to form the desired layer. Chemical vapor deposition is just one process of providing thin layers on substrate assemblies and other surfaces, such as films of elemental metals or compounds, e.g., platinum, ruthenium, ruthenium oxide, etc. The CVD process may be enhanced by various related techniques such as plasma assistance, photo assistance, laser assistance, as well as other techniques.

The CVD process for depositing ruthenium and/or ruthenium oxide is conducted with a ruthenium containing precursor being delivered to a reaction chamber. Diluent gases may also optionally be provided to the reaction chamber. One skilled in the art will recognize that the manner in which the gases are introduced into the reaction chamber may include one of various techniques.

Gas products contained within the CVD system are potentially harmful to personnel located around the equipment. The present invention provides methods of detecting the escape of the selected materials based on their deposition onto a detection surface and the resulting change in the conductivity of the detection surface.

Referring to Figure 5, a sensor 410 according to the present invention is located in proximity to a CVD system 460 in which ruthenium or ruthenium or ruthenium oxide is to be deposited. In some systems, ruthenium oxide may be formed in the CVD system 460 if it is supplied with oxygen in addition to ruthenium for the purpose of forming ruthenium oxide on a substrate.

A sensor 410 according to the present invention, however, may be able to detect gaseous ruthenium oxide that escapes from the system 460. The sensor 410 includes at least two electrodes 420 and 430, a detection surface 440 extending between the electrodes 420 and 430, and a detector 450 capable of detecting a change in the conductivity between the electrodes 420 and 430. The detector 450 preferably includes an electrical circuit capable of detecting the conductivity change between electrodes 420 and 430 through the film formed on the detection surface 440.

If gas phase ruthenium tetraoxide escapes from the CVD system 460, it will typically form ruthenium oxide by oxidation reduction upon contact with the detection surface 440 of the sensor 410. In the case of ruthenium oxide, the detection surface 440 may include exposed polymeric materials or glass. On example of a useful polymer on which ruthenium oxide may be preferentially deposited is polypropylene, thereby potentially enhancing detection of any gas phase ruthenium oxide. The deposited film or coating is electrically conductive and, as a result, a change in the conductivity of the detection surface 440 between the electrodes 420 and 430 can be used to indicate the presence of ruthenium oxide gas in the area of the sensor 410, thereby alerting personnel in the area or those monitoring an unoccupied area of a potential hazard.

It may be desirable to, e.g., heat the detection surface 440 above the ambient temperature using a heater 470 to potentially enhance sensitivity of the sensor 410. For example, heating the detection surface 440 may limit deposition of ambient moisture vapor or organic materials present in the atmosphere around the detection surface 440. In the case of ruthenium oxide detection, heating the detection surface up to about 100°C may be useful to enhance detection.

The heater 470 should be capable of providing thermal energy to the detection surface 440 by any suitable manner including conduction, convection, and/or radiation. In addition, the heater 470 may be an electrical resistance heater, operate using RF excitation, infrared radiation, etc.

All patents and references cited herein are incorporated in their entirety as if each were incorporated separately. This invention has been described with reference to illustrative embodiments and is not meant to be construed in a limiting sense. Various modifications of the illustrative embodiments, as well as additional embodiments of the invention, will be apparent to persons skilled in the art upon reference to this description. It is therefore contemplated that the appended claims will cover any such modifications or embodiments that may fall within the scope of the present invention as defined by the accompanying claims.

What is claimed is:

1. A method of detecting a gas phase material comprising:

providing a sensor comprising first and second electrodes, a detection surface extending between the first electrode and the second electrode, and a detector operatively connected to the first and second electrodes;

exposing the detection surface to the gas phase material, wherein an electrically conductive film forms on the detection surface between the first and second electrodes; and

detecting a change in conductivity between the first and second electrodes with the detector.

2. A method according to claim 1, wherein the gas phase material comprises ruthenium.

3. A method according to claim 1, wherein the gas phase material comprises ruthenium tetraoxide.

4. A method according to claim 1, wherein the gas phase material comprises iridium.

5. A method according to claim 1, wherein the gas phase material comprises rhodium.

6. A method of detecting a gas phase material comprising:

providing a sensor comprising first and second electrodes, a detection surface extending between the first electrode and the second electrode, and a detector operatively connected to the first and second electrodes, wherein the detection surface is not electrically conductive;

exposing the sensor to the gas phase material, wherein an electrically conductive film forms on the detection surface between the first and second electrodes; and

detecting electrical conductivity of the electrically conductive film between the first and second electrodes with the detector.

7. A method according to claim 6, wherein the detection surface comprises a polymer.

8. A method according to claim 6, wherein the detection surface comprises polypropylene.

9. A method according to claim 6, wherein the detection surface comprises glass.

10. A method of detecting a gas phase material comprising:

providing a sensor comprising first and second electrodes, a detection surface extending between the first electrode and the second electrode, and a detector operatively connected to the first and second electrodes;

heating the detection surface above ambient temperature;

exposing the detection surface to the gas phase material, wherein an electrically conductive film forms on the detection surface between the first and second electrodes; and

detecting a change in conductivity between the first and second electrodes with the detector.

11. A method according to claim 10, wherein the gas phase material comprises ruthenium, and further wherein heating the detection surface comprises heating the detection surface up to about 100°C or less.

12. A sensor for detecting a gas phase material in an environment, the detector comprising:

first and second electrodes;

a detection surface extending between the first electrode and the second electrode;

a detector operatively connected to the first and second electrodes.

13. A sensor according to claim 12, wherein the detection surface comprises a polymer.

14. A sensor according to claim 12, wherein the detection surface comprises polypropylene.

15. A sensor according to claim 12, wherein the detection surface comprises glass.

16. A sensor according to claim 12, wherein the detector comprises an electronic circuit capable of detecting a change in electrical conductivity between the first and second electrodes.

17. A sensor for detecting a gas phase material in an environment, the detector comprising:

first and second electrodes;

a detection surface extending between the first electrode and the second electrode;

a heater capable of providing thermal energy to the detection surface; and

a detector operatively connected to the first and second electrodes.

18. A sensor according to claim 17, wherein the detection surface comprises a polymer.

19. A sensor according to claim 17, wherein the detection surface comprises glass.

20. A sensor according to claim 12, wherein the detector comprises an electronic circuit capable of detecting a change in electrical conductivity between the first and second electrodes.

DETECTION OF GAS PHASE MATERIALS

Abstract of the Invention

Sensors and methods of monitoring for the presence of gas phase materials by detecting the formation of films based on the gas phase material are disclosed. Advantageously, some gas phase materials preferentially deposit on specific surfaces. As a result, selective detection of those gas phase materials can be obtained by detecting films deposited on those detection surfaces. Examples of gas phase materials that may be detected include RuO_4, IrO_4 and RhO_4.

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PRINTED NAME Jill E. Price

SIGNATURE Jill E. Price

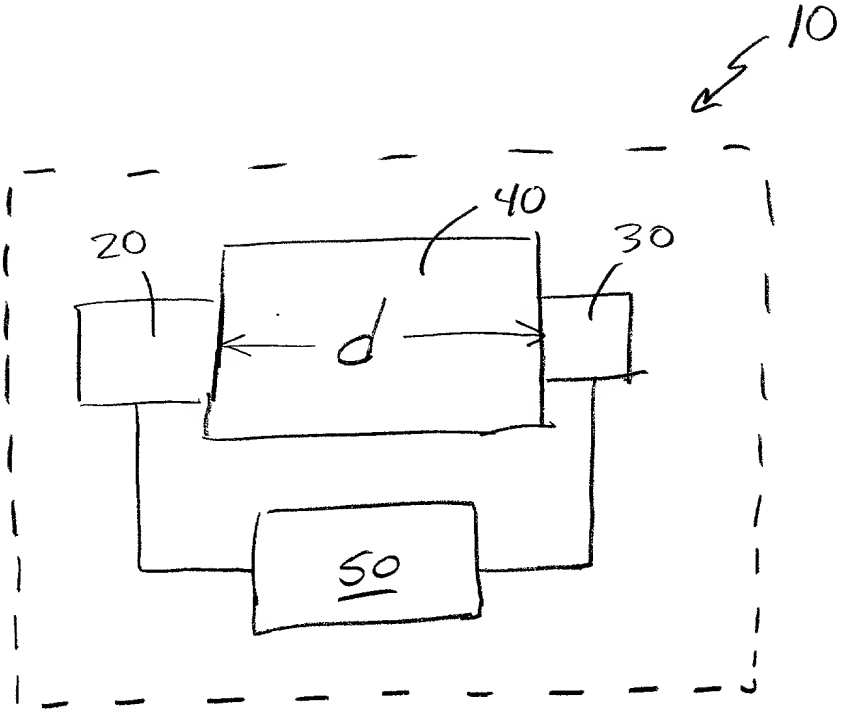

FIG. 1

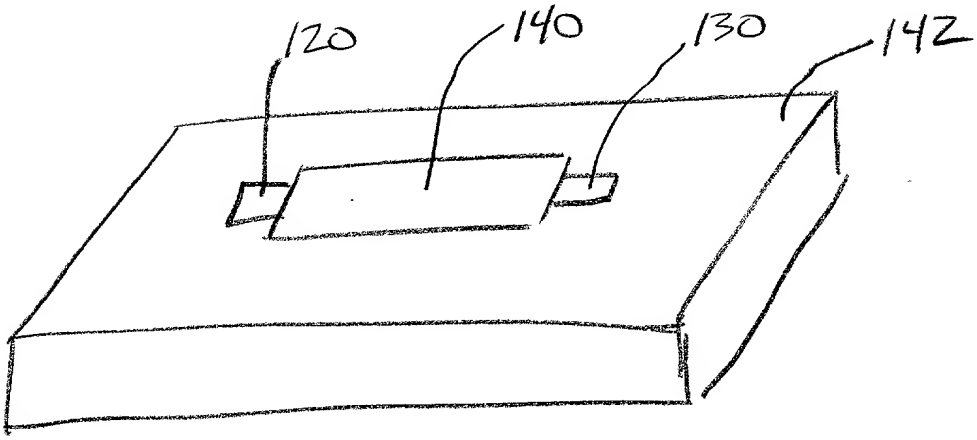

FIG. 2

MICRON 99-0062

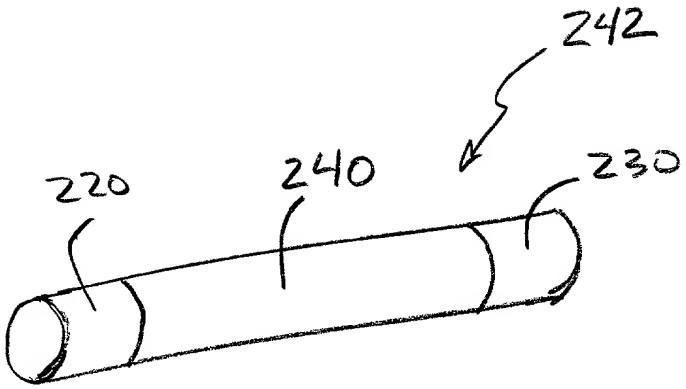

FIG 3

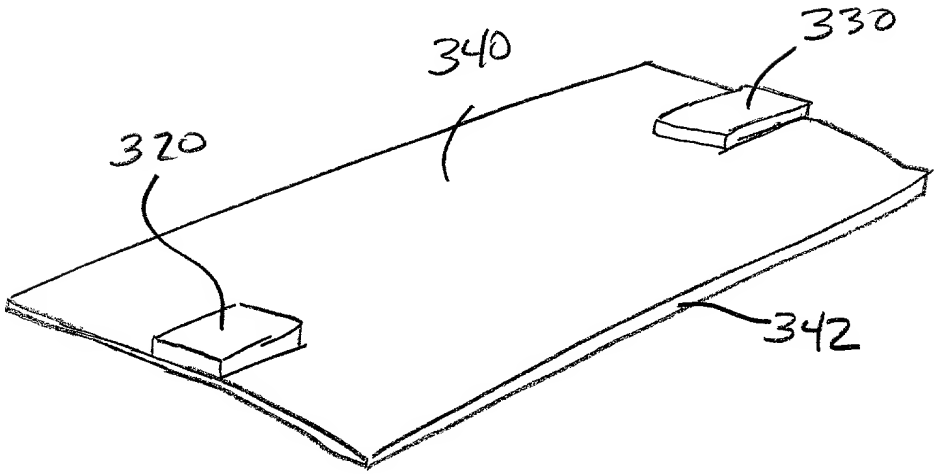

FIG. 4

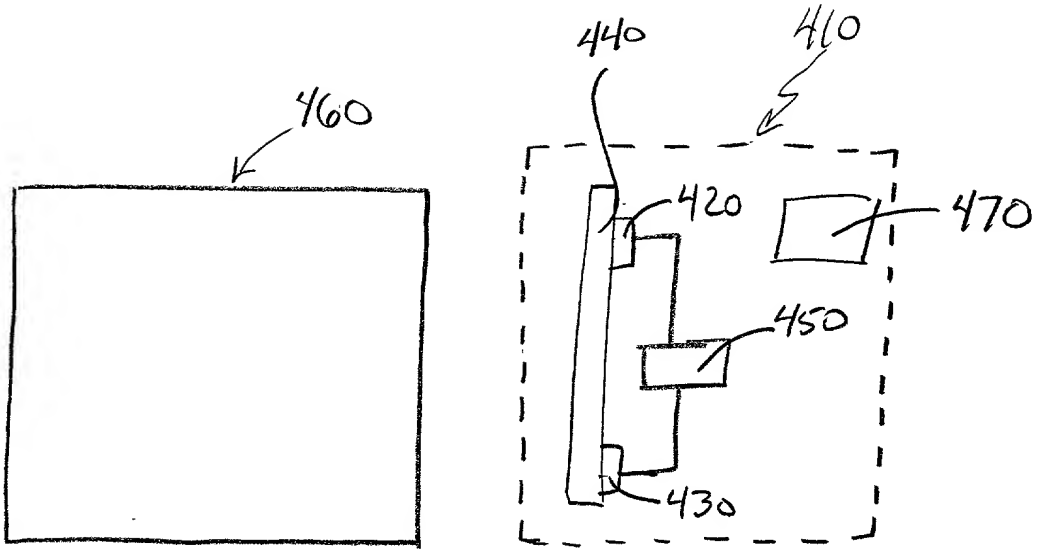

FIG. 5

MICRON 99-0062

Docket 150.01010101

DECLARATION

I, Guy T. Blalock, the sole inventor of the invention claimed declare that: (1) my citizenship and mailing address are indicated below; (2) I have reviewed and understand the contents of the specification identified below, including the claims, as amended by any amendment specifically referred to herein, (3) I believe that I am the original and first inventor of the subject matter in

DETECTION OF GAS PHASE MATERIALS

Filed: Herewith Serial No.: Unassigned

described and claimed therein and for which a patent is sought; and (4) I hereby acknowledge my duty to disclose to the Patent and Trademark Office all information known to me to be material to the patentability as defined in Title 37, Code of Federal Regulations, §1.56.*

The undersigned declares further that all statements made herein of his/her own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Wherefore, I pray that Letters Patent be granted to me for the invention described and claimed in the specification identified above and I hereby subscribe my name to the foregoing specification and claims, Declaration and Power of Attorney, on the date indicated below.

9/1/99

Name Guy T. Blalock Date
Citizenship: USA
Address: 8101 Silkwood Court, Boise, Idaho 83704

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(a) A patent by its very nature is affected with a public interest. The public interest is best served, and the most effective patent examination occurs when, at the time an application is being examined, the Office is aware of and evaluates the teachings of all information material to patentability. Each individual associated with the filing and prosecution of a patent application has a duty of candor and good faith in dealing with the Office, which includes a duty to disclose to the Office all information known to that individual to be material to patentability as defined in this section. The duty to disclose information exists with respect to each pending claim until the claim is cancelled or withdrawn from consideration, or the application becomes abandoned. Information material to the patentability of a claim that is cancelled or withdrawn from consideration need not be submitted if the information is not material to the patentability of any claim remaining under consideration in the application. There is no duty to submit information which is not material to the patentability of any existing claim. The duty to disclose all information known to be material to patentability is deemed to be satisfied if all information known to be material to patentability of any claim issued in a patent was cited by the Office or submitted to the Office in the manner prescribed by §§1.97(b)-(d) and 1.98. However, no patent will be granted on an application in connection with which fraud on the Office was practiced or attempted or the duty of disclosure was violated through bad faith or intentional misconduct. The Office encourages applicants to carefully examine:

(1) Prior art cited in search reports of a foreign patent office in a counterpart application, and

(2) The closest information over which individuals associated with the filing or prosecution of a patent application believe any pending claim patentably defines, to make sure that any material information contained therein is disclosed to the Office.

(b) Under this section, information is material to patentability when it is not cumulative to information already of record or being made of record in the application, and

(1) It establishes, by itself or in combination with other information, a prima facie case of unpatentability of a claim; or

(2) It refutes, or is inconsistent with, a position the applicant takes in:

(i) Opposing an argument of unpatentability relied on by the Office, or

(ii) Asserting an argument of patentability.

A prima facie case of unpatentability is established when the information compels a conclusion that a claim is unpatentable under the preponderance of evidence, burden-of-proof standard, giving each term in the claim its broadest reasonable construction consistent with the specification, and before any consideration is given to evidence which may be submitted in an attempt to establish a contrary conclusion of patentability.

(c) Individuals associated with the filing or prosecution of a patent application within the meaning of this section are:

(1) Each inventor named in the application;

(2) Each attorney or agent who prepares or prosecutes the application; and

(3) Every other person who is substantively involved in the preparation or prosecution of the application and who is associated with the inventor, with the assignee or with anyone to whom there is an obligation to assign the application.

(d) Individuals other than the attorney, agent or inventor may comply with this section by disclosing information to the attorney, agent, or inventor.

*Title 37, Code of Federal Regulations, §1.56 is reproduced on the attached page.

PATENT
Docket No. 150.01010101

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant(s):	Guy T. Blalock	Group Art Unit:	Unknown
Serial No.:	Unassigned	Examiner:	Unknown
Filed:	Herewith		
For:	DETECTION OF GAS PHASE MATERIALS		

ELECTION UNDER 37 C.F.R. §§3.71 AND 3.73 AND POWER OF ATTORNEY

Assistant Commissioner for Patents
Washington, D.C. 20231

Dear Sir:

The undersigned, being Assignee of the entire interest in the above-identified application by virtue of an Assignment recorded in the United States Patent and Trademark Office as set forth below or filed herewith, hereby elects, under 37 C.F.R. §3.71, to prosecute the application to the exclusion of the inventor(s).

The Assignee hereby revokes any previous Powers of Attorney and appoints: Ann M. Mueting (Reg. No. 33,977); Kevin W. Raasch (Reg. No. 35,651); Mark J. Gebhardt (Reg. No. 35,518); Mark A. Hollingsworth (Reg. No. 38,491), Victoria A. Sandberg (Reg. No. 41,287), Paul B. Simboli (Reg. No. 38,616), and David L. Provence (Reg. No. 43,022); Michael L. Lynch (Reg. No 30,871); Lia M. Pappas (Reg. No. 34,095); W. Eric Webostad (Reg. No. 35,406); Walter M. Fields (Reg. No. 37,130); Charles B. Brantley, II (Reg. No. 38,086); Susan B. Collier (Reg. No. 34, 566); Kevin D. Martin (Reg. No. 37,882); and David J. Paul (Reg. No. 34,692)

as its attorney or agent (with full powers of appointment, substitution, and revocation) to prosecute the application, and any division, continuation, continuation-in-part, reexamination, or reissue thereof, to make alterations and amendments therein, and to transact all business in the Patent and Trademark Office in connection therewith, and to receive any Letters Patent.

Pursuant to 37 C.F.R. §3.73, the undersigned certifies that the evidentiary documents have been reviewed, specifically the Assignment to Micron Technology, Inc. referenced below, and certifies that to the best of my knowledge and belief, title remains in the name of the Assignee.

Please direct all communications as follows:

Attention: Kevin W. Raasch
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Date: Aug 1, 1999

By: _____
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ASSIGNMENT:

X Concurrently filed herewith for recording, a copy of which is attached hereto.